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ABSTRACT

Reported is a study designed to determine the relative influence of selected variables on student attitude and success in a course in physical science for elementary education majors. Success measures were the number of units a student completed during the semester and the student's end of course attitude toward both the course and the method of instruction. Nine variables were selected for use in the study and included factors related to academic achievement, critical thinking ability, previous science and mathematics courses completed in high school and college. An equation was formulated to predict the number of units a student will complete in a semester (.05 level of confidence). Five variables were found to contribute significantly to the prediction equation for units completed: cumulative grade point average, number of science and/or mathematics courses completed, score on pretest achievement assessment, class membership (freshman, sophomore, etc.), and grade contracted for. The three variables most influential in predicting student attitude were the pretest form of the Laboratory Attitude Inventory score, number of science and/or mathematics courses completed, and grade point average. The student's attitude at the start of the semester contributed 18.67 percent of the observed variance, indicating that attitudes are developed early, persist, and have a strong influence. (Authors/PEB)

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PREDICTORS OF ACHIEVEMENT IN AN AUDIO-TUTORIAL PHYSICAL SCIENCE COURSE

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INTRODUCTION

Science Educators have long speculated about the appropriate content and method of instruction to be used in physical science courses for non-science majors. One method which is currently being researched is audio-tutorial instruction. This method of instruction is presently being used in Ed C140 Studies in the Physical Sciences I at the University of Maine, Orono, Maine.

The course described in this study was developed for elementary education majors who usually have negative attitudes about the physical sciences and generally avoid them in their teaching careers (Butzow and Pare, 1972). The major objectives of the course are to provide a first-hand experience with a number of physical science phenomena and to improve the student's ability to observe, analyze, and draw conclusions. Secondary objectives are to have the student become familiar with the historical background and importance of the experiments they perform and to improve the student's attitude towards physical science.

The data analyzed in this study was acquired during the fall semester of the 1972-73 academic year. It was collected from students enrolled in Ed C140, Studies in the Physical Sciences I. The course is completely mediated via audio-tapes, 35mm slides, super 8mm film-loops and video tape. The primary mode of instruction is through the use of integrated slide-tape presentations. The material in the course is divided into units designed to be of three weeks' duration. Students are asked to contract for the number of units they will complete. Grades are determined by the amount of work completed. The conditions of the contract are set forth in

the course syllabus which the students receive at the first meeting of the course. After the first three meetings attendance is no longer required and the student may attend when he wishes and stay as long as he desires within the framework of the laboratory schedule. Students may work a maximum of thirty-nine hours per week in the laboratory.

Students are required to keep a notebook of all experiments completed. The notebooks must be passed in at the conclusion of a unit and are then evaluated by one of the instructors. Evaluation is on a pass-fail basis. A notebook that is rejected is returned to the student with a complete diagnosis of the difficulties detected by the instructor. The student then must make any corrections requested and resubmit the notebook. Upon completion of the notebook requirement, the student is asked to take a unit quiz. The unit quiz is usually a practical application of the unit objectives involving experimental work. The completed unit quiz is then evaluated and accepted or rejected. A rejected quiz necessitates a conference with the instructor to correct false impressions and in some cases remedial work (experimental in nature) is assigned. A second conference is then held to determine the success of the remedial work, and a new quiz is given.

All students are required to pass a test on the history of science as part of the course. All tests are evaluated on a pass-fail basis with a score of sixty-five as a minimum passing grade. A short text on the history of science is assigned.

THE PROBLEM

This study was designed to determine the relative influence of selected variables on student attitude and success in the course Ed C140 Studies in

the Physical Sciences I. The results of the study were used to determine if either of two success measures could be predicted from knowledge of the selected variables. The success measures were: the number of units a student completed in a semester and the student's end of course attitude towards both the course and the method of instruction.

HYPOTHESES

The hypotheses tested in this study were:

A. It is not possible to predict the number of units a student will complete in a semester with knowledge of the following factors:

1. Attitude towards the method of instruction and the course itself. The attitude assessment made at the start of the semester is used.
2. The independence of student work habits as measured by the Study Preference Record.
3. Scholastic Aptitude Test scores: both verbal and mathematical.
4. The student's cummulative grade point average as it appears on the student's records.
5. Critical thinking ability as measured by the Watson-Glaser Critical Thinking Appraisal.
6. The number of science and/or mathematics courses a student has completed in the past. This was determined by counting the number of semesters a student has completed in science and/or mathematics in both college and high school.
7. Student's class membership, how he is classified by the College of Education, as a freshman, sophomore, junior, senior or graduate student.

8. Prior knowledge of general science as measured by the Cooperative General Science Test Advanced Form B.
9. The grade for which a student contracts for at the start of the semester.

B. It is not possible to predict either the student's final attitude towards the course or the method of instruction with knowledge of the variables slated for hypothesis A.

PRESENTATION AND ANALYSIS

The following numbers are used to identify the corresponding variables in all calculations and tables:

1. Student Identification Number.
2. Student attitude towards the course as measured by the attitude pre-test.
3. Student attitude towards the method of instruction as measured by the attitude pre-test.
4. Score on the first administration of the Watson-Glaser Critical Thinking Appraisal.
5. The independence of student work habits as measured by the test of independence.
6. Student score on the Scholastic Aptitude Test verbal section.
7. Student score on the mathematical section of the Scholastic Aptitude Test.
8. Student class -- 1=Freshmen 2=Sophomore 3=Juniors 4=Seniors 5=Graduate Students.
9. The student's cummulative grade point average.
10. Score on the second administration of the Cooperative General Science Test.
11. The number of science and/or mathematics courses taken in the past.
12. The average time spent on a unit.
13. Total time to complete all units.
14. The final grade of the student in the course.
15. The grade the student initially contracted for.
16. Student attitude towards the course on the pre-test attitude assessment.
17. Student attitude towards the method of instruction as measured on the pre-test attitude assessment.
18. Score on the Cooperative General Science Test -- first administration.
19. The number of units completed in the semester.
20. The score of the student on the Watson-Glaser Critical Thinking Appraisal, first administration.

HYPOTHESIS A

Hypothesis A stated that: It will not be possible to predict the number of units a student will complete in a semester using knowledge of variables 5, 6, 7, 8, 9, 11, 15, 16, 17, 18, and 20. The results of a step-wise linear regression indicate that it is possible to use knowledge of those variables to formulate an equation which is significant at beyond the .05 level of confidence in predicting the number of units a student will complete in a semester. Table 1 is a list of the variables used in the equation in the order they were entered into the equation. The computed program CORREG enters the variables in the most beneficial order.

Results. The results indicate that it is possible to use knowledge of the included variables to formulate an equation to predict the number of units a student will complete in a semester. Hypothesis A is, therefore, rejected. The included variables account for 34.24% of the observed variance.

TABLE 1

Variables Used in Predicting the Number of Units a Student Will Complete in the Semester

Pure Constant		Error of Coefficient		
-.123		.903		
Variable Number	Coefficient		F Value for each variable	% unique variance contributed
9	.815	.241	9.03	9.3
11	.07	.021	6.16	6.0
18	-.034	.017	8.78	7.84
8	-.177	.100	4.39	3.78
17	-.009	.862	2.22	1.88
15	.022	.017	3.28	2.7
5	.025	.02	1.4	1.2
6	.026	.024	1.25	1.0
20	.011	.014	.59	.48
7	-.004	.001	.08	.06
16	-.001	.019	.004	.01

R square = .3424

Regression F for equation 3.69

HYPOTHESIS B

Hypothesis B stated that: It is not possible to predict either the students' final attitude towards the course or the method of instruction using knowledge of variables 5, 6, 7, 8, 9, 11, 15, 16, 17, 18 and 20. The calculations indicate that it is possible to predict the students' attitude towards the course at the conclusion of the semester, but it is not possible to predict the students' attitude towards the method of instruction. Table 2 is a list of the variables used in predicting the final attitude of the student towards the course. Table 3 is a list of the variables used in predicting the final attitude of the student towards the method of instruction.

Results. The results indicate that it is possible to use the factors specified in constructing an equation to predict the students' attitude towards the course at the conclusion of the semester. The resulting equation is significant at beyond the .05 level of confidence. Of the observed variance, 32.55% is attributable to the factors used in the equation. Hypothesis B concerning attitude towards the course is, therefore, rejected.

TABLE 2

Variables Used in Predicting the Final Attitude of the Student Towards the Course

Pure Constant	Error of Coefficient
10.67	9.77

Variable Number	Coefficient		F Value	% unique variance
16	.925	.203	20.21	18.67
11	.412	.222	5.46	4.81
9	3.80	2.60	3.19	2.75
17	-.153	.092	2.27	1.92
15	-.181	.187	.974	.82
7	.023	.016	.909	.77
18	-.240	.179	1.325	1.12
8	1.25	1.09	1.53	1.28
5	.111	.220	.367	.31
6	.006	.018	.096	.08
20	-.017	.150	.013	.01

R square = .3254

Regression F 3.42

TABLE 3

Variables Used in Predicting the Final Attitude of the Student Toward the Method of Instruction

Pure Constant		Error of Coefficient		
24.54		28.47		
Variable Number	Coefficient		F Value	% unique variance
16	1.39	.501	6.42	6.80
8	4.87	3.16	1.82	1.91
7	.080	.047	1.52	1.59
18	-.730	.522	2.26	2.33
5	.678	.642	1.16	1.19
17	-.184	.272	.958	.98
9	6.71	7.6	.614	.63
6	-.0269	.052	.315	.33
15	-.27	.544	.177	.19
11	.265	.648	.207	.22
20	-.024	.437	.003	.003

R square = .1617

Regression F 1.37

Concerning attitude toward the method of instruction, the equation derived from all of the included factors is not significant at the .05 level of confidence. It is, therefore, not possible to estimate the attitude of the student at the end of the course towards the method of instruction. On the basis of these results, the hypothesis that it is not possible to predict the final attitude of the students towards the method of instruction is accepted. There is one factor which is significant in predicting the final attitude toward the method. The attitude of the students towards the course as measured by the pre-test has an F value of 6.42 which is a significant value but it accounts for only 6.80% of the variance observed.

INTERPRETATION OF FINDINGS

The results of testing hypothesis A indicate that it is possible to formulate an equation that is significant beyond the .05 level of confidence in predicting the number of units a student will complete in a semester. While the entire equation (with the inclusion of all factors) is significant, there are certain variables that do not contribute a significant amount to the equation when they are added. There were five variables that contributed significantly to the prediction equation. These five variables were, the student's cummulative grade point average, the number of science and/or mathematics courses a student has had in the past, the score of the student on the pre-test achievement assessment, the class membership of the student, and the grade the student contracted for. These five factors contributed 29.62% of the observed variance. The remaining variables, independence of work habits, Scholastic Aptitude Test scores (both verbal and mathematical),

attitude (toward both the course and the method of instruction) and critical thinking ability can account for an additional 4.62% of the observed variance.

These findings indicate that the measures of student aptitude (verbal and mathematical), achievement and the number of courses in science and/or mathematics previously taken are the best predictor variables. Two of the variables which were the best predictor variables, the student's cummulative grade point average and his prior knowledge of general science, were significantly correlated (.29) and thus may actually be measures of the same factor. The variables of student class membership and the number of courses in science and/or mathematics previously taken were also significantly related (.30). These factors are actually measures of the student's background in academic areas and are thus related as such.

One factor which was not influential in this or any of the other prediction equations was the independence of work habits as measured by the Study Preference Record. This was not expected. The author's experience with the course during other semesters led to the expectation that the ability of the student to work unaided would be an important factor. When evaluating the Study Preference Record, a point bisereal correlation of the student's score on the Study Preference Record with the fact that the student did or did not complete all of the work he had elected to do in the semester showed a highly significant (.478) correlation. This would indicate that independence is a factor in the success of the student. In addition to the point bisereal correlation, a correlation of the student's score on the Study Preference Record with the number of units completed in the semester yielded a significant (.22) correlation. These results appear contradictory to the fact that independence was not a significant contributor to the regres-

sion equations formulated. The non-contribution of this factor appears to be in agreement with other studies (Haakosen, 1969; Meleca, 1970; Szabo and Feldhusen, 1971; and McDuffie, 1972) that indicate that personality variables are not significantly related to achievement. There is a possible explanation for the discrepancy. It may be that the amount of help available to the student compensated for any handicap due to the lack of independence on the part of the student. It appears that in this type of course that the Study Preference Record can discriminate between students who will and will not achieve the goals they have set, but it does not discriminate well enough as to the degree of attainment of the students' goals to act as a predictor variable that contributes to the prediction of achievement at a significant level.

Hypothesis B stated that it would not be possible to predict the final attitude of the student toward the course or the method of instruction. The results of testing hypothesis B indicated that it was possible to predict the attitude of the student toward the course but not toward the method of instruction.

There were three variables that were most influential in predicting the final attitude of the student toward the course. These were, student attitude toward the course as measured by the pre-test form of the Laboratory Attitude Inventory, the number of science and/or mathematics courses a student had previously taken, and the grade point average of the student. These three factors accounted for 26.65% of the observed variance. The addition of the remaining factors contributed only an additional 5.86% of the observed variance. The student's attitude at the start of the semester contributed 18.67% of the variance. This is a substantial amount to be attributable to one factor.

This would indicate that while the student's attitude scores have been shown to decrease significantly during the sem ster, the attitudes that have developed as early as the first week are persistant and have a strong influence on how the individual student feels at the end of the semester.

Testing of Hypothesis B as it applies to attitude toward the method of instruction revealed that it was not possible to predict how the student would feel towards the audio-tutorial approach at the conclusion of the semester. This could be due to the lack of experience with the course. The student were very enthusiastic at the start of the semester but as the semester progressed many students became less enthusiastic.

The overall results of testing hypotheses A and B indicate that both scholastic aptitude and past experience are influential in determining all of the aspects of success that were examined in this study. They are also influential in determining attitude toward the course. While there was considerable variance accounted for by most of the equations formulated, in all cases there was still approximately 2/3 of the observed variance remaining unaccounted for. It should also be noted that while the equations formulated were significant at beyond the .05 level of confidence (excluding the prediction of attitude toward the method of instruction) the equations were not very accurate in their predictions. The residuals obtained are a good indication that the equations leave much to be desired in their accuracy. While the accuracy of the equations is less than what was hoped for, a search of the available literature indicates that this study has succeeded in accounting for more of the observed variance than any other study encountered.

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